

tion of short time before the heart muscle must yield to the strain. When such a dire event is imminent the various measures just advocated must be carried out promptly and with judgment, since delay and indiscretion may be tantamount to the proverbial locking of the barn-doors after the horses have been stolen.

A PROPER SHOE AS AN AID TO TREATMENT IN FLAT (OR WEAKENED) FEET.

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THERE is considerable confusion and misunderstanding in the minds of many of the profession in regard to flat-foot. The term as applied in many instances is misleading. The weakened foot goes through a series of changes, beginning with a disability known as pronated foot and ending with the deformity of rigid flat-foot (Figs. 1 to 7). The term flat-foot cannot be used to designate all the stages of this trouble, but should be restricted to one phase of the progressive weakened condition.



FIG. 1.—Weak and painful foot; slight pronation; arch not obliterated by weight-bearing.

Recently¹ I discussed the series as regards etiology, symptoms, diagnosis, and treatment, and stated that two of the chief aids to treatment are a proper brace and a proper shoe. Subsequently² I discussed fully the indications for a brace and described a form of brace which had been found useful in these weakened conditions. In the present article I wish to point out some of the advantages of a proper shoe, and describe its form and manufacture.

¹ Albany Med. Annals, April, 1906.

² Ibid., September, 1906.

A brace is absolutely necessary at times and almost always beneficial; but, in order that a brace may have its full benefit, it should be used in conjunction with a proper shoe. The possibility of recovery and ultimately giving up of the brace is due, in large measure, to the use of a proper shoe; but I must emphasize the fact that, as all of treatment is not in a brace, neither is it in a brace even when used in conjunction with a proper shoe. Patients walk with their



FIG. 2.—Weak and painful foot; pronation; obliteration of the arch by weight-bearing.



FIG. 3.—Markedly weak foot; painful; marked pronation; obliteration of the arch by weight-bearing.

feet and not with a brace or shoe, and, therefore, they must strengthen their feet. Strength comes from a brace or shoe only as it is properly used. The physician can supply braces and shoes, but the patients must cure themselves. The physician can put the foot in a proper position, but whether the foot retains that position or not depends on strength of the foot, and strength of the foot can be brought about only by active exercise, gymnastics, etc., on the part of the patient.

In a former article the foot was compared to a machine, and it

was stated that inasmuch as one of the causes of the breaking down of a machine is defective support, so when there is defective support to a foot in the form of an improper shoe, there is likely to be a breaking down of the foot. Furthermore, since when a machine is broken down it would not be a wise policy to repair the machine and leave a poor support, likewise there is little use in correcting a weakened or deformed foot and leaving uncorrected a poor support in the form



FIG. 4.—Markedly weak foot (same as Fig. 3); normal appearance of the left foot when the weight is removed.



FIG. 5.—Flat and painful foot; not rigid.

of an improper shoe. It follows, therefore, that a proper shoe is indicated in all weakened conditions of the foot; moreover, a proper shoe is not only a therapeutic agent but also a prophylactic measure.

The question might be asked, Why do we wear shoes at all? The human race, that is, the more civilized portion, has worn some form of foot covering for centuries, and, in many ways, the history of shoes is closely associated with the history of the race. Hill in his *History of English Dress*, in discussing the origin of clothes,

says that it involves many principles of psychological interest. In the primitive state the factors which first prompted man to devise raiment and which tend to modify it are: protection (as becomes a more roving animal), climate, occupation, habits, and ornamentation. In a more advanced stage of civilization modifications arise through idiosyncrasies of taste, wealth, rank, and intercourse with other nations.



FIG. 6.—Rigid flat-foot; not painful.



FIG. 7.—Rigid and painful flat-foot. Note the enlargement of the bones.

From the first, man was a roving animal and for protection to the feet devised sandals or, in colder climates, some form of moccasin. From these two elements, sole without upper and upper without sole, was evolved the modern shoe. In present times shoes have become not only a bodily necessity, but a necessity for fashion. In many instances their real use has been lost sight of and they are used principally to make the foot look well, or rather to conform to fashion's decree of what looks well.

The history of shoes shows a constant change from broad toe to

pointed toe, from low heel to high heel. Sad to say, in spite of all the agitation that has been made at various times in favor of more perfect footwear, fashion still rules, and shoes are not much better adapted for the foot than they were hundreds of years ago. One might be tempted to cry out in a perversion of Madame Roland's famous passage, "Oh fashion, fashion, how many crimes are committed in thy name!"

It seems remarkable what a hold on the race the attempt to improve on nature in regard to the shape of the foot has taken. Read a description of the heroine's shod foot in any ancient or modern novel. Instead of describing a broad-toed, well-adducted foot, there is described the small, high-heeled, pointed-toed shoe. It requires only a little knowledge to read between the lines of the aching, burning feet inside and the nervous drain consequent upon their use.

In the time of the Plantagenets in England the toes of shoes became so long and pointed that laws were passed prohibiting their make; and the clergy were empowered to put under a curse those who extended their toes beyond the ordinary length. It was, however, the introduction of the fashion of broad-toed shoes which really put an end to the "Polish Points," rather than the majesty of the law. These new shoes became as exaggerated and absurd as the long, pointed shoes. Gladstone said of fashions: "It is a wheel going round and round, always puzzling you like a fireworks wheel, but always landing in a total negation of progress and with a strong tendency to the substitution of mere caprice for the real pursuit of beauty."

The rise and fall of heels might be used as an index of the times; there have been alternating low and high heels as fashion dictated. Sir Thomas Parkins, writing in 1714 in his *Treatise on Wrestling*, says: "For shame, let us leave off aiming at the outdoing our Maker in our true symmetry and proportion; let us likewise, for our own ease, secure treading and upright walking as He designed we should, and shorten our heels."

It is of interest to note that women have always worn shoes more inadequate for "walking abroad" than men. It is only as late as 1828 that boots for women's wear came into fashion.

In the early history of the United States, the travelling shoemaker journeyed from home to home making the shoes for the family. A last for the largest foot in the family, usually the father's, was whittled out first and a shoe made over it, and the last was then whittled down for each smaller foot in the family. Today the American shoes lead the world in excellence and cheapness of manufacture, but it is doubtful if they have improved much in their influence on the foot. In a comparatively recent article, Bradford calls attention to the fact that deformities of the foot change with fashion, thus giving rise to different deformities for different periods of history. The foot is capable of a great deal of distortion by shoes,

but limitations in its usefulness must of necessity result. When the patient adapts himself to these limitations there is no trouble, but so soon as active use is demanded of the foot it sooner or later shows the effect of the strain. The common expression of breaking in a shoe really means breaking in the foot.

The reformer in shoes meets with some hard experiences. Custom and fashion have such a strong hold on the public that it is not an easy matter to persuade people that their shoes are at fault. In fact, some patients, especially women, cannot at once change from their old shoes to a proper shoe because the change is too great. The shoe habit is almost as bad as the morphine or whisky habit; when patients first give up the old and try the new way, they feel worse than they did under the old.

Another difficulty is found in patients—here again usually women—who try to wear two kinds of shoes: a proper shoe part of the time, and the old, narrow-toed, high-heeled shoe the rest of the time. One cannot serve the two masters of right and fashion when applied to modern footwear. It is difficult to understand why patients will choose to suffer from and treat calluses, corns, and painful feet instead of correcting that which is causing the trouble.

There is a class of patients who are afflicted with markedly weakened feet; oftentimes the arch has begun to fall, and they are wearing a soft, flabby shoe, resembling a moccasin with none of its advantages. The physician advises a stiff shoe with some support and one in which a brace could be used with benefit. The patients complain that they cannot get a shoe to fit and that they *cannot possibly* wear a stiff shoe: they have tried to do so repeatedly, but cannot. Of course, they cannot with any shoe they would buy themselves; but fit their feet with proper shoes and braces and the chances are that not only would they be able to wear the shoes, but the trouble would clear up at once.

How often the physician hears the complaint, "I cannot get a pair of shoes to fit me." Even when the patient gets custom-made shoes, he may not get comfortable shoes, for, as a rule, the custom-made shoes are constructed on the same principle as the ready-made shoes, only not so well made unless the patient is fortunate in his shoemaker. A prominent German writer, Hosebroek,³ advises patients to get their shoes at a large establishment because they generally fit the foot better. The trouble is by no means always due to the shoe being too tight. In some ways it may be better to have a shoe too tight rather than too loose. Josh Billings is credited with saying: "There is one thing that can be said in favor of tight boots, they make us forget all our other troubles."

The chief faults with modern shoes are that they follow fashion in an attempt to improve on Nature in regard to the shape and

³ Zeit. f. Ortho. Surg., xi, 2.

appearance of the human foot; they cramp the foot; and they hold the foot in faulty attitudes. Bradford⁴ calls attention to arboreal traits in the human foot manifest in infants, and states that these rapidly disappear with the use of shoes. Hoffinan⁵ draws some interesting conclusions from a comparative study of the feet of barefooted and shoe-wearing peoples. He concludes that the "forms, function, and range of voluntary and passive motion are the same in both up to the time of shoe wearing, after which progressive characteristic deformation and inhibition of function ensue. Here as in other instances acquired characteristics are not transmitted. The shoe wearers inherit the same type of foot as do those of barefooted races, and this type is changed only in so far as footwear modifies it." He experimented with savages who had never worn shoes and found that foot deformities begin to occur after only a few weeks of shoe wearing.

The normal positions of the foot, both in the passive attitude and during activity, are well discussed by Whitman.⁶ Bradford admirably describes the normal walk, and in an article entitled "Proper Footwear and the Treatment of Weakened and Flat Feet by Mechanical Devices for Maintaining the Adducted Position" Sampson⁷ emphasizes the value of the adducted position. There are, therefore, certain postures which are normal whether the foot is at rest or in use, and if these normal postures are interfered with in any way the foot is placed in a false position and is consequently under a strain.

What, then, are the requirements of a proper shoe? In the first place it should be understood that there is nothing elaborate about a proper shoe; it is simply a shoe that supports the foot in its normal position when at rest and allows the normal motions to take place during activity. In order that these may occur the shoe must, of necessity, be an individual shoe made for that foot alone. As has been previously stated, the expression of "breaking in the shoe" really means breaking in the foot. I do not understand why people should use ready-made shoes any more than ready-made teeth.

A proper shoe should have a low heel with little or no spring to the sole, thus allowing the toes to come to the ground. They should be broad enough across the ball of the foot to give full play to the weight-bearing portion. The shank should be to the outer side of the shoe (where the weight of the foot comes) instead of in the middle, as in the ordinary shoe. The front part of the shoe should have the same angle of adduction as is normal to that individual foot. In the proper shoe there is no attempt made to improve on Nature,

⁴ Boston Med. and Surg. Jour., November 24, 1904; Jour. of Med. Research, May, 1902; Amer. Jour. Orthopedic Surg., April, 1905.

⁵ Ibid., October, 1905.

⁶ Text book of Orthopedic Surgery.

⁷ Johns Hopkins Hosp. Bull., 1902, xiii, No. 130.

but when nature has been violated an attempt may be made at correction.

Care should be taken, especially in weakened feet, to keep the heels of the shoes built up and not allow them to become worn off on one side. This is a very important point. I have recently seen a case illustrating this point. The patient was wearing a proper shoe and I could not understand why pain was present in the foot until I observed that the heels were worn off on one side. On correction of this fault the pain promptly disappeared.

To a certain extent the profession and the general public are becoming alive to the importance of proper footwear. Almost all the large shoe manufacturers are putting on the market shoes advertised as beneficial in flat-foot troubles. No attempt will be made to explain or even enumerate the individual features on which the manufacturers base their claims of a proper shoe.

Many of the shoes are excellent, but the great fault is that they are not shoes for the individual foot, that is, they are not custom-made. There are various shoes on the market which have a brace incorporated into the shoe. This is a bad idea, because when the brace is made into the shoe, the shoe becomes a splint to the foot.

What is, theoretically, an excellent scheme for throwing the weight of the body on to the outer side of the foot in walking has been devised by a Boston shoemaker. The shoe has a soft, flexible shank, and a square of rubber is inserted into the forward and outer portion of the heel of the shoe. The idea is that in walking the back of the heel will strike the ground first, then as the weight falls on the forward portion of the heel the rubber portion on the outer side gives and the weight of the body is thrown to that side.

I wish to describe what I shall call the Sampson last and shoe. Dr. Sampson in a paper, the title of which I have already quoted, discussed these fully from a mechanical standpoint; in the present article they will be considered more as regards their practical application.

The special features of the last are as follows: The last is shown in Fig. 8, *A*. It is so constructed that the line of body weight projected on from the middle line of the leg and ankle falls over the centre of the last. As regards this point, compare Fig. 8, *B*, the last of a modern fashionable shoe. The effect of weight-bearing on the two types of lasts is shown in Fig. 9. The shank is placed to the outer side of the last and there is no external longitudinal arch unless imprints show the presence of an "island foot," in which case the last is given a slight external longitudinal arch. There is little or no spring to the front part of the last, that is, it comes in contact with the ground for its whole length. The under surface of the last is concaved to correspond to the transverse arch of the foot. The last is thickest over the inner side corresponding to the position of the big toe (the thickest portion of the front part of the foot) and dimin-

ishes in thickness to the outer side. There is a fulness in the last corresponding to the situation of the big-toe joint; the toe of the last is rounded instead of pointed, and it has the same angle of adduction as the foot for which it is made. The outer edge is nearly straight.

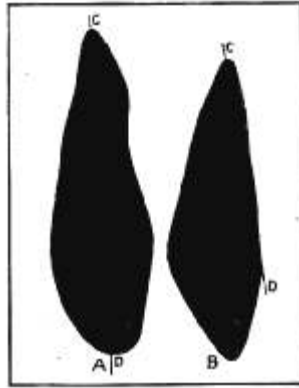


FIG. 8.—*A*, Sampson last. Note that the line of body weight, *C-D*, falls over the centre of the last. *B*, last of a modern fashionable shoe. Note that the line of body weight, *C-D*, falls to the inner side of the last.

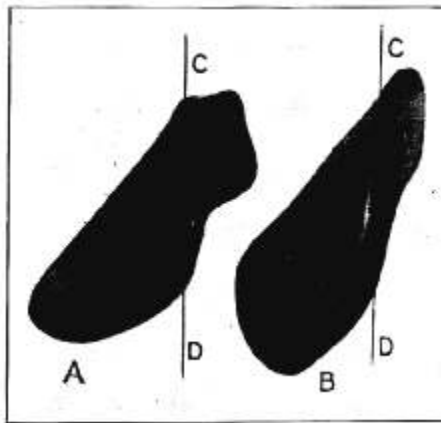


FIG. 9.—*A*, Sampson last; *B*, modern fashionable last. Note the effect of a force (body, weight) acting downward along the lines *C-D*. *A*, remains firm; while *B*, tilts to the inner side.

The shoe is made over this last and, of course, has the same shape and characteristics. The shoe is preferably a high, laced shoe. The heel should be low with a firm counter grasping the heel of the foot. There should be an extra-stiff counter in certain cases when a brace is used with the shoe, and there is a marked tendency to running over at the heel. As a rule, the shoe should have a stiff

steel shank, and this is an essential when a brace is used; otherwise the brace would force the shank down and the support would be lost.

Nearly every writer on the treatment of flat-foot conditions mentions the value of a proper shoe, but only a certain number of these writers give the reader any hint as to what a proper shoe is and a still smaller number describe the manner of getting a proper shoe made. I wish to describe briefly the method which I employ in getting for the patient a proper last and shoe.

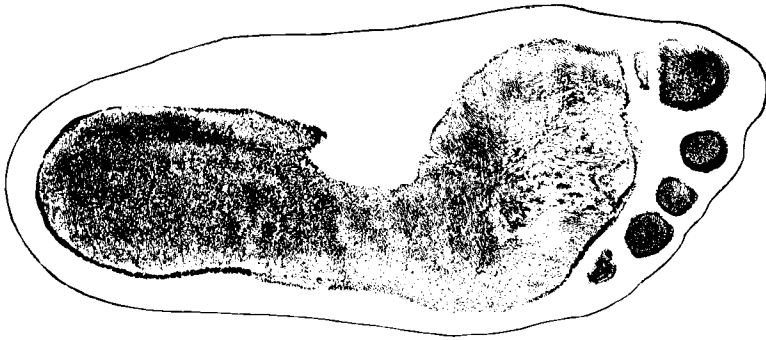


FIG. 10.—Impression of the weight-bearing portion of the foot, and a tracing of the outline of the foot.

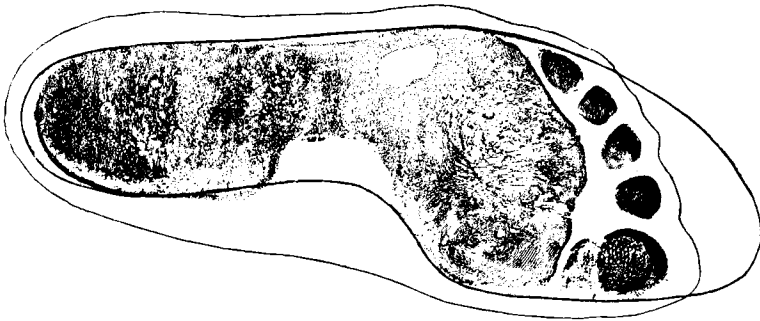


FIG. 11.—Inner sole pattern for the last, made with the imprint and the tracing as a guide.

The first thing to be obtained is an imprint of the foot. A mixture of 1 part of lampblack, 1 part of powdered acacia, and 3 parts of water (a mixture which can be readily washed from the foot) is thinly spread on a sheet of plate glass by means of an ink roller. The patient steps on this with one foot with his whole weight, thus blackening its under surface. He is then instructed to raise his foot, and after the glass has been replaced by a sheet of rough white paper to bring it down upon the paper and rest his full weight upon it. A tracing is then made around the foot. When the foot is placed

upon the paper care should be taken that it is held parallel to the other foot, since in that position the feet have their normal amount of adduction. On the patient's removing his foot there is obtained what is shown in Fig. 10—an impression of the weight-bearing portion of the foot, together with a tracing of the foot. The imprint shows the full weight-bearing portion during activity and also the amount of adduction normally present. An inner sole pattern for

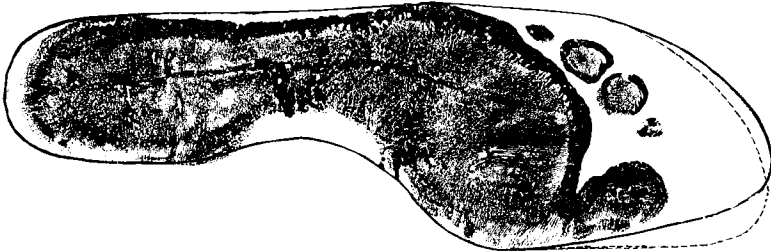


FIG. 12.—Illustrating the differences between the regulation shape of a shoe and a shoe with a straight inner edge.

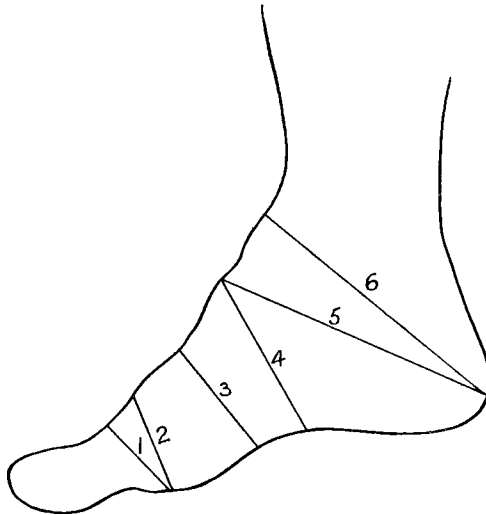


FIG. 13.—Illustrating the method of measuring the foot for a proper shoe.

the last is now marked out with the imprint and the tracing as a guide (Fig. 11). The custom shoemaker ordinarily blocks out the inner sole pattern from the outline of the foot alone, and consequently is apt to disregard both the weight-bearing portion of the foot and the normal adduction.

With nearly everyone who has worn shoes there is a slight hallux valgus present. Theoretically, the inner side of the inner sole

pattern should be straight to allow of adduction of the big toe, but ordinarily, unless there is marked hallux valgus calling for treatment (the wearing of a toe-post, etc.) it is customary to allow the toe of the shoe to conform more to the regulation shape, since it has been found that the toe will rarely move in to fill the vacant place that would be left were the edge made straight (Fig. 12).

The services of a shoemaker are now called in and measurements of the foot are taken as follows: (1) Circumference of the foot over the big and the little toes; (2) the ball of the foot; (3) the waist; (4) the instep; (5) the heel and the top of the instep, and (6) the heel (Fig. 13). Measurements are also taken for the ankle and the top of the shoe. These measurements and the inner sole patterns are now sent to the lastmaker.

The lastmaker has a model last in stock and he makes for the patient a last similar to the model last, but having an inner sole pattern and measurements corresponding to the patient's foot. The last is now returned to the shoemaker, who makes any little change that may be necessary to ensure a more perfectly fitting shoe, and the shoe is made. It will, of course, be understood that separate inner sole patterns, measurements, and lasts have to be made for both feet of the patient.

In conclusion, I would say that most excellent results have followed the use of a proper shoe such as has been described. There is almost always some difficulty on the part of the patient in becoming accustomed to the new shape; but in a few days the discomfort wears away and the freedom of motion and comfort consequent upon the use of properly constructed shoes soon cause him to become an earnest advocate of their use.

THE TREATMENT OF COMPRESSED-AIR (CAISSON) ILLNESS.

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WHILE compressed-air illness, or caisson disease, is an affection which is seldom seen by the general practitioner, it is becoming of considerable interest on account of the growing necessity for increased transportation facilities and the consequent need for underground tunnels, bridges, and other structures which necessitate the sinking of caissons. The disease occurs as a result of work in compressed air at pressures greater than the normal fifteen pounds to the square inch, and is believed to be due to the presence of gas emboli in the circulation. A discussion of its causation, however, is beyond the scope of this paper.